FTIR characterization of isolated fruit cuticles from tomato species

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Cultivated tomato together with 12 related wild species are included in the *Lycopersicon* section of the genus *Solanum*. Their geographical distribution covers the countries Colombia, Peru, Ecuador, Bolivia and Chile as well as the Galapagos islands. They are adapted to a wide range of altitudes and variable environmental conditions, which allow them to be an excellent source to improve different traits in the cultivated tomato.

The plant cuticle is a lipid extracellular membrane which covers the outer surface of leaves, stems and fruits of higher plants acting as a real interphase between the plant and the environment. The cuticle plays a pivotal role in epidermal development, control of water loss, fruit integrity, firmness and resistance to various disorders [1]. From a morphological point of view, the cuticle (Figure 1) can be described as a cutinized epidermal cell wall [2]. Based on its structural and chemical composition, the cuticle is mainly constituted by a polyester matrix of long chain polyhydroxy fatty acids named cutin. Additionally, a significant amount of polysaccharides (mainly cellulose, hemicellulose and pectin) is also present. Cuticular waxes, a mixture of different very long chain aliphatic compounds, can be either embedded into the cutin matrix (intracuticular waxes) or deposited on the outer surface of the cuticle (epicuticular waxes) [3]. Finally, phenolic compounds (cinnamic acid derivatives and flavonoids) are also present. In tomato, cuticular flavonoids participate in fruit coloration and their presence is influenced by environmental conditions and the stage of development.

As it can be observed in Figure 1, the cuticle has an asymmetrical distribution of its components. In its outer surface waxes and aliphatic compounds are very abundant, while the inner surface is rich in polysaccharides from epidermal cell wall.

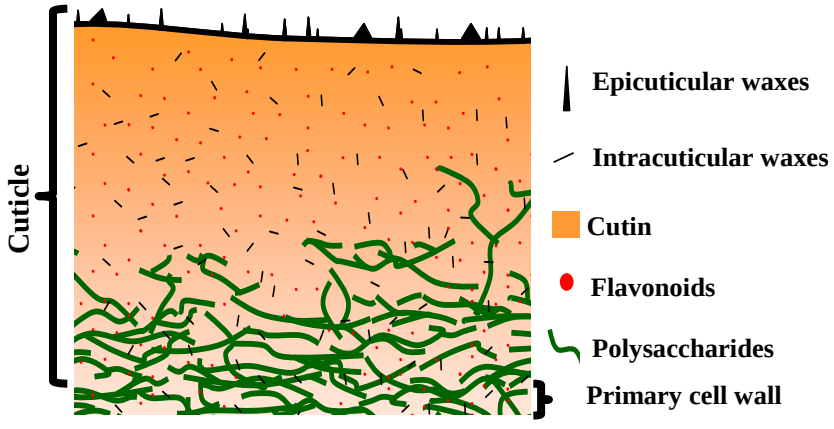

Figure 1. Scheme of a transverse section of the plant cuticle

In order to characterize the differences among the species of the *Lycopersicon* section, an FTIR analysis of the enzymatically isolated cuticles has been performed. Two parameters have been studied, the esterification index (the ratio between the intensities of the stretching vibration band related to ester functional groups (1730 cm^{-1}) and the stretching vibration associated with methylene groups (2918 cm^{-1})), which is a relative measure of the cross-linking degree of the cutin matrix, and the amount of flavonoids, calculated as the sum of 1606 cm^{-1} and 1624 cm^{-1} band areas.

Our results indicate that the esterification index of the outer side varies depending on the species while the esterification index in the inner side hardly varies among them; and that flavonoids are more abundant in the outer side than in the inner one. The inherent compositional asymmetry of the plant cuticle between inner and outer side is sharply reflected in all analysed species. This asymmetry has been studied through carbonyl group band deconvolution to distinguish between free ester (1730 cm^{-1}), hydrogen bonded (1705 cm^{-1}), and free fatty acid (1690 cm^{-1}). It was found that the main H bonding interactions are associated with the polysaccharides amount, not existing a significate correlation with the quantity of phenolic compounds.

References

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